Catching gamma ray bursts on the fly . . .

Mission Operations Center (MOC)
to
Swift Data Center (SDC)
Interface Control Document (ICD)

Swift-OMI-005

Baseline
Version 1.3

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Swift Ground Segment

Omitron Inc.

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REVISION STATUS

This document is controlled by the Swift Ground Segment Project. Changes require prior approval of the PSU Operations Lead and the Ground Segment Manager. Proposed changes shall be submitted to Doug Spiegel, Swift Ground Segment Manager, Omitron, Inc. (301) 474-1700, doug.spiegel@omitron.com.

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1.1	6/17/02	Doug Spiegel	Updated As-flown timeline, Preplanned science timeline, and ACS timeline formats; corrected As-flown file naming convention; revised description of file transfers to SDC
1.2	10/21/02	Doug Spiegel	Corrected typo in file extension for "pass completed" signal file; Added new event types "SAA", "Slew Settled" in As-Flown Timeline; added Integrated Contact Schedule file definition and example; added definition of ACS Timeline signal file
1.3	11/20/02	Doug Spiegel	Altered contents of "pass completed" signal file per E. Pier; added Sequence # field to As-Flown Timeline

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1.0 INTRODUCTION

1.1 PURPOSE

This Interface Control Document (ICD) defines the interfaces, formats, schedules, and procedures for delivering products between the Swift Mission Operations Center (MOC) located at The Pennsylvania State University (PSU), State College, Pennsylvania (PA) and the Swift Data Center (SDC) located at Goddard Space Flight Center (GSFC) Greenbelt, Maryland.

1.2 SCOPE

This document governs the technical interfaces, product deliveries, and protocols between the MOC and the SDC. Specific message and data product examples are included in the appendices. This document does not define high-level science data production (i.e., "Level 1" data products). This ICD does not define Swift data interfaces with spacecraft or instrument vendor sites, non-MOC customers at PSU, European data archives, or the Gamma-Ray Burst (GRB) Coordinates Network (GCN).

1.3 DOCUMENTATION

1.3.1 Applicable Documents

The interfaces defined in this ICD were derived from high-level requirements contained in the following sources:

- "Swift Science Requirements Document", GSFC-661-Swift-SRD [Science Requirements Document], 410.4-SPEC-0005D, 12 March 2001.
- "Swift Mission Requirements Document", 410.4-SPEC-0004, Version 1.4, 10 October 2000.
- "Requirements of the Ground System for the Swift Mission", 410.4-SPEC-0007, Revision 1.0, 12 September 2000.
- "Swift Interface Requirements Document", 410.4-ICD-0001A, Version 2.0A, 20 December 2000.

1.3.2 Reference Documents

The following documents contain background information relevant to this ICD:

- "Swift Mission Operations Concept Document," Swift-OMI[Omitron]-001, Baseline Version 1.1, July 2001.
- Kelso, T.S. "Frequently Asked Questions: Two-Line Element Set Format." *Satellite Times*, vol. 4 no. 3, January 1998.
- "MOC Design Specification Document," Swift-OMI-003, Preliminary Version, August 2001.
- CCSDS 701.0-B-2**: "***Advanced Orbiting Systems, Networks and Data Links: Architectural Specification*. Blue Book." Issue 2. November 1992. (Reconfirmed June 1998.)
- "Swift Spacecraft to Mission Operations Center (MOC) Interface Control Document" 1143-EI-MO22927 CDRL 5.2, 24 May 2001.
- "Malindi TT&C Station to MOC Interface Control Document," TN/SWIFT/0002/TPZ, 27 September 2001.

- "Swift Onboard Operational Messaging Interface Document" 410.4-ICD-0006 Revision-1.02 August 9, 2001.

2.0 FACILITIES OVERVIEW

2.1 SWIFT GROUND NETWORK DESCRIPTION

The Swift ground system is comprised of new and existing facilities. The Ground Network for Swift (GNEST) is the organizational entity responsible for ensuring that interface requirements are met between ground system elements. The interface between the MOC and SDC will be tested and verified as part of the GNEST mission readiness test program.

The MOC is responsible for operating the spacecraft and its payload. The SDC is responsible for processing Swift telemetry into scientifically useful data sets and for making these data available to the community. The Italian Swift Archive Center (ISAC) and the United Kingdom Data Center (UKDC) will provide services for scientists in those countries. The Swift Science Center (SSC) at GSFC will support the community with data analysis and will also provide tools for analyzing Swift data. The Italian Space Agency's (ASI) Malindi ground station and NASA's (National Aeronautics and Space Administration) Space Network (SN) will provide the primary communication links with Swift. The instrument teams are responsible for providing detailed knowledge of the operation and calibration of the instruments. The spacecraft contractor, Spectrum Astro, will provide detailed knowledge of the operation of the spacecraft. The Swift Ground System mission architecture overview is shown in Figure 2-1.

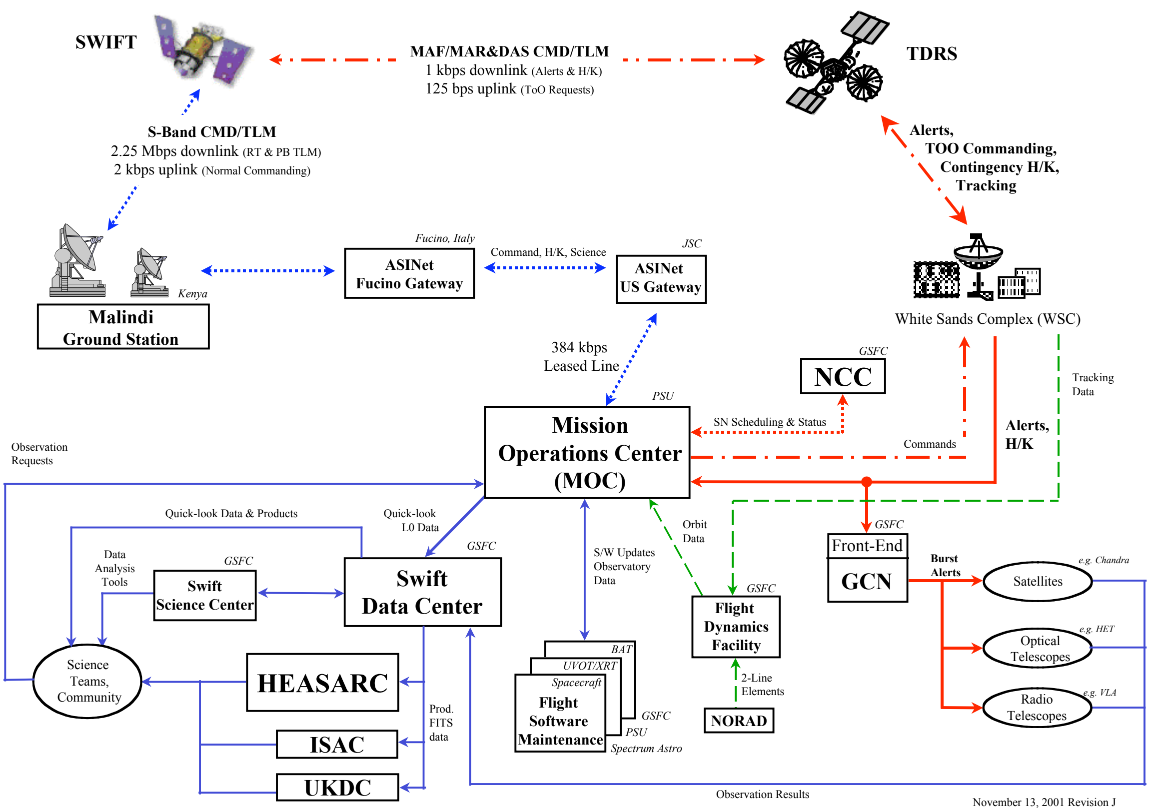

Figure 2-1: Swift Mission Architecture

The Swift Principal Investigator (PI) is the ultimate authority for all decisions concerning the mission. The Swift Science Team will review the implementation strategies of the ground system and provide recommendations to the PI.

The High Energy Astrophysics Science Archive Research Center (HEASARC) is the designated U.S. data center responsible for public access and long-term archive. All data from Swift observations will be rapidly delivered to the three Swift data centers. These data centers will make the data available electronically to the public.

2.2 MOC DESCRIPTION

The MOC performs all spacecraft and instrument mission planning, commanding, monitoring, and data processing and delivery to the SDC. The MOC provides rapid response for the follow-up of new GRBs detected by the spacecraft, and for Target of Opportunities (ToOs) requested by the science team or science community. The MOC incorporates automation of spacecraft operations and data processing to permit a small operations team and "lights-out" operation, and to speed data processing and response to GRBs and ToOs. The MOC will be staffed by a Flight Operations Team (FOT) and a Science Operations Team (SOT) on an eight-hour per day, five-day per week basis. MOC automation software will monitor anomalies and page personnel if necessary. Archiving of all raw and Level 0 (L0) data for the mission is provided off-line with rapid retrieval of the last 7 days. A 30-day on-line archive of housekeeping telemetry, command transmissions, and MOC processing statistics and status is maintained.

The MOC is based on the Integrated Test and Operations System (ITOS) command and telemetry system, government-off-the-shelf (GOTS), and commercial-off-the-shelf (COTS) hardware and software tailored for Swift mission support. ITOS provides all command and telemetry functions, such as front-end processing, command and telemetry processing, real-time monitoring, and archiving. Computer security, with use of firewalls and other techniques, prevents intrusion and disruption of operations.

The MOC shall receive all transfer frames from the Malindi ground station or the Tracking and Data Relay Satellite System (TDRSS) SN link. The MOC shall produce L0 products (also referred to as "pass-oriented L0") and deliver these products to the SDC. The L0 processing functions include the decoding of transfer frames, the extraction of Consultative Committee for Space Data Systems (CCSDS) packets, and the creation of L0 products with associated quality and gap accounting. All Swift transfer frames shall be archived as received from the ground station (or TDRSS) by the MOC for the duration of the mission.

2.3 SDC DESCRIPTION

The SDC pipeline data processing system produces Level 1, 2, and 3 data sets and standard products from the L0 data provided by the MOC. The SDC is staffed during normal business hours, five days per week. The pipeline runs autonomously 24 hours a day, 7 days a week; it is activated automatically by receipt of L0 data from the MOC.

The SDC converts Swift L0 data into Flexible Imaging Transport System (FITS) files and standard data products using an automated processing pipeline. The format of the FITS files is consistent with Office of Guest Investigator Program (OGIP) standards. The data sets are organized by target to facilitate later scientific analysis. Quick-look data products are made on a shorter time scale using less complete telemetry. The SDC will serve quick-look products directly to the public by anonymous File Transfer Protocol (ftp).

The SDC delivers processed production data to the HEASARC at NASA/GSFC and to data centers in the UK (United Kingdom) and Italy, which will in turn serve them to the public. The data centers provide expertise in the scientific analysis of Swift data. The HEASARC will store all in-flight data, relevant calibration data, analysis software, and documentation.

2.4 DATA INTERFACE

Figure 2-2 shows the data interfaces between the MOC and the SDC. Level 0 data, ACS (Attitude Control System) timeline, as-flown science timelines, spacecraft clock offset logs, and NORAD (North American Aerospace Defense Command) TLE (Two Line Element) sets will be sent to the SDC electronically. The remaining products will be made available to the SDC in a public web server at the MOC.

The MOC will have the capability to deliver products to the SDC at a minimum data rate of 1 Mbps (megabits/sec). Data file transfers between the MOC and the SDC shall use an established ftp standard, including secure transfer formats. The MOC will notify the SDC once the products are available. All files shall be compressed, and transmission errors shall be monitored autonomously.

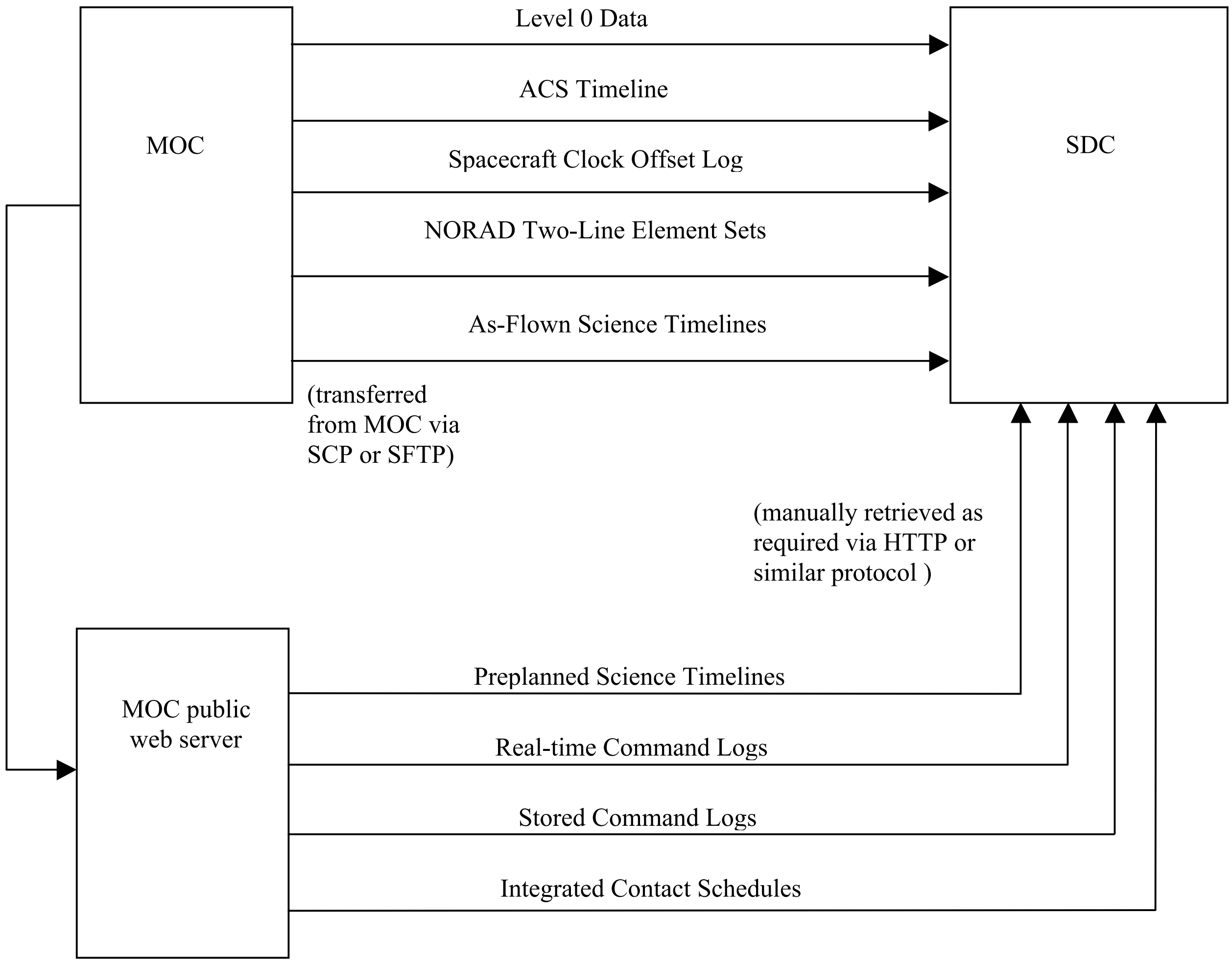

Figure 2-2: MOC - SDC Interface

3.0 PRODUCTS AND FORMATS

Table 3-1 summarizes all of the products transferred between the MOC and the SDC. The appendices provide samples of each product. The following subsections provide more detail on each product's content and attributes.

Table 3-1: MOC Data Products

Product	Contents	Timespan	Delivery Rate	Transfer Media	Size
Level 0 data sets	Processed packets from a single Ground Station or TDRSS pass with meta-data	1 recorder dump (1-3 orbits)	Once per pass	FTP or secure equivalent	approx. 45-160 Mbyte/pass
ACS timeline file	Start and stop times of each Observation Number	Length of mission	Once per pass	FTP or secure equivalent	approx. 1 Mbyte at end of mission
Spacecraft Clock Offset Log	Clock offset and most recent clock correction factor	Length of mission (all clock data is appended to single historical file)	As needed (approx. once per week)	MOC public web page	<100 kbyte at end of mission
NORAD TLEs	Most recent NORAD TLE set and cumulative list of previous TLE sets in ASCII format	Length of mission	As received from TLE source (NASA, NORAD, etc.)	MOC public web page	approx. 150 kbytes at end of mission
As-flown science timeline files	Time-ordered list of instrument observations	1 mission day, 24-hour boundary	Once per workday	MOC public web page	<100 kbyte
Preplanned science timeline files	Time-ordered list of instrument observations	1 mission day, 24-hour boundary	Once per workday	MOC public web page	<100 kbyte
Real-time command logs	Time-ordered list of real-time commands	1 mission day, 24-hour boundary	Once per day	MOC public web page	TBD
Stored command logs	Time-ordered list of all ATS commands	1 mission day, 24-hour boundary	Once per day	MOC public web page	TBD
Integrated Contact Schedule Files	List of predicted pass times for ground stations	1 mission week	Once per schedule update	MOC public web page	<100 kbyte?
Anomaly notifications	Brief notification and description of spacecraft (S/C) or MOC anomalies	N/A	As needed	Email or voice	Variable

This ICD follows the CCSDS bit ordering and bit significance convention for serial telemetry links as shown in Figure 3-1. The first bit in a field of N bits is defined as “Bit 0” (i.e., the most left justified appears first in this ICD and is the first transmitted); the following bit is defined as “Bit 1” and so on up to “Bit N-1”. Data fields are grouped into 8-bit “words” called octets or bytes. Each byte contains an American Standard for Code Information Interchange (ASCII) character or binary data.

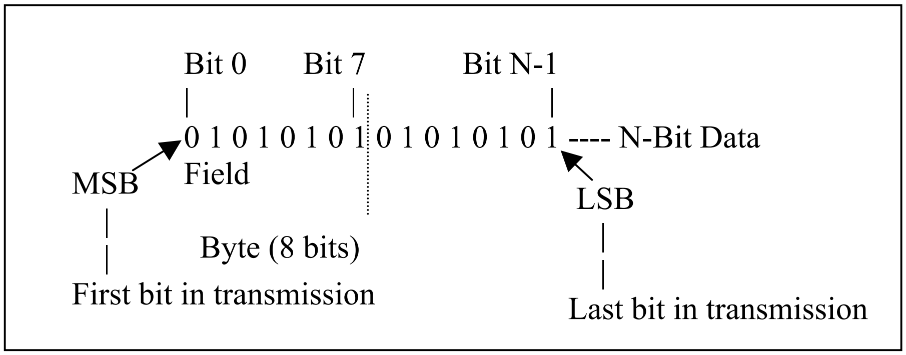

Figure 3-1: Data Format Convention

3.1 LEVEL 0 DATA

The MOC shall receive all CCSDS-compliant telemetry frames from the Malindi ground station and the TDRSS Demand Access Service (DAS) link. L0 products will be generated on all mission telemetry and maintained within the mission archive at the MOC. The L0 processing functions include the decoding and correction of RS encoded transfer frames, the extraction of CCSDS packets sorted by Application Process ID (APID), and the creation of L0 products with associated quality and gap accounting. The MOC will forward the L0 data products electronically to the SDC within 45 minutes after receipt of data from a ground-station contact.

The MOC manages the receipt, recording, processing to L0, and archiving of raw and L0 Swift telemetry. This includes managing the on-board spacecraft recorder and scheduling of ground contacts. Daily spacecraft data volume is approximately 5.4 Gbits.

After each Malindi pass, the MOC will receive Virtual Channel (VC) telemetry frame files. Data received from TDRSS (VC5) will be collected into a file containing cumulative data from one Malindi pass to the next. As each file is received, the MOC will automatically process the file through the ITOS frame sorter task. ITOS will create individual packet files with appended Annotation Headers organized by APID. The MOC will take all packet files for a given VC and compress the files (i.e., via GZIP or a similar protocol) prior to storing the data on the MOC fileserver. The MOC will then send a signal file (directory listing) to the SDC providing a notification of available data. The SDC will retrieve the available files from the MOC fileserver via FTP or secure equivalent.

3.1.1 Data Format

ITOS will extract the CCSDS Version 1 Telemetry Source Packets from the CCSDS telemetry frames. The structure of the CCSDS Path Protocol Data Unit (CP_PDU) is shown in Figure 3-2.

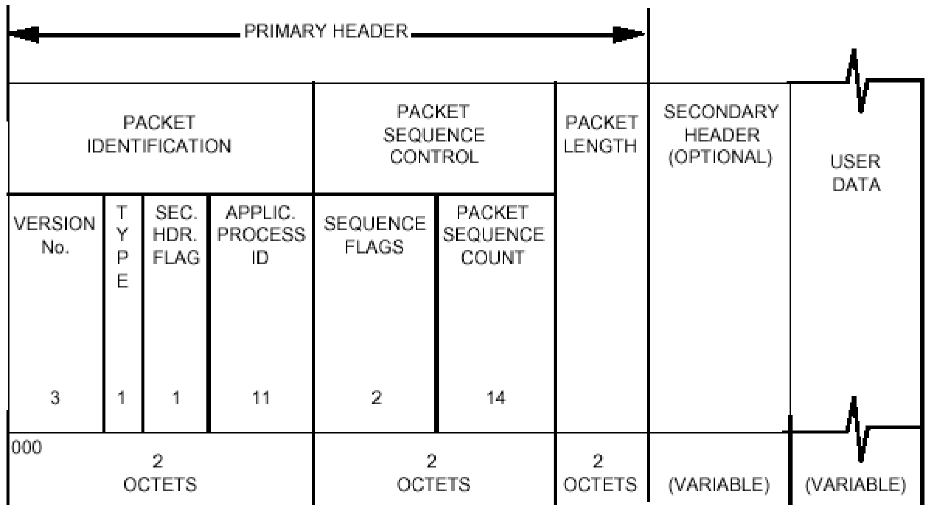

Figure 3-2: CCSDS Path Protocol Data Unit

The Primary Header shall consist of 6 bytes subdivided into the following fields shown in Table 3-2. [CCSDS 701.0-B-2 (Blue Book), Section 3.3.3].

Table 3-2: CCSDS Primary Header Format

Field Name	Sub-Field Name	#Bits	#Bytes
Packet Identification	Version Number	3	
	Type	1	
	Secondary Header Flag	1	
	Application Process ID	11	2
Packet Sequence Control	Sequence Flags	2	
	Packet Name or Sequence Count	14	2
Packet Length		16	2
TOTAL		48	6

A single ITOS Packet Data Unit (PDU), shown in Figure 3-3, consists of a CCSDS telemetry source packet annotated with a 12-byte quality information header.

ANNOTATION HEADER (12 bytes)	CCSDS TELEMETRY SOURCE PACKET

Figure 3-3: Packet Data Unit

The packet annotation header is 12 bytes in length; the packet annotation header format is shown in Table 3-3.

Table 3-3: Packet Annotation Header Content and Format

Field	Word (16-bit)	Bit Location	Description/Values
Frame version	1	Bits 0-1	Copied from transfer frame header
Frame spacecraft identifier (SCID)	1	Bits 2-11	Copied from transfer frame header
Frame VCID (Virtual Channel ID)	1	Bits 12-14	Copied from transfer frame header
Reserved	1	Bit 15	
Reed-Solomon Enabled	2	Bit 0	0 = RS error detection and correction not enabled 1 = RS error detection and correction enabled
Reed-Solomon error	2	Bit 1	0 = no uncorrectable RS error detected 1 = uncorrectable RS error detected
Reed-Solomon corrected	2	Bit 2	0 = no RS error detected 1 = RS corrected one or more error
Reserved	2	Bit 3	
Time format	2	Bits 4-7	Defines time code format.
Packet header error	2	Bit 8	0 = packet from frame without CRC (Cyclic Redundancy Check) error 1 = packet from frame with CRC error
Data direction	2	Bit 9	0 = data received in forward order 1 = data received in reverse order
Packet sequence error	2	Bit 10	0 = no discontinuity found in packet sequence count 1 = this packet's sequence count not successor of previous packet with same APID on same VC
Frame CRC error	2	Bit 11	0 = no CRC error detected 1 = CRC error detected in one or more frames from which this packet is extracted
Frame error checking enabled	2	Bit 12	0 = frame error checking not enabled 1 = frame error checking enabled
Incomplete packet	2	Bit 13	0 = packet is complete 1 = packet is incomplete and filled to specified length (see "location of fill")
VC sequence error	2	Bit 14	0 = no discontinuity found in frame VC sequence count 1 = Transfer frame's VC sequence count is not successor of previous frame on same VC

Field	Word (16-bit)	Bit Location	Description/Values
Frame header error	2	Bit 15	0 = no error 1 = SCID or transfer frame version was not the expected value
Location of fill	3	Bits 0-15	0 to 65,535 (unsigned value); identifies first byte of fill data in byte offset from end of packet primary header
Ground receiving time	4-6	Bits 0-15	Local processing time in format defined in "time format", word 2, bits 4-7 above

3.1.2 Level 0 File Naming Convention

The Level 0 file naming convention will be as follows:

```
PKT_YYYYDOYhhmm_nnnnn_VCNN_ppppp.0.gz
```

where:

- PKT is a fixed field indicating that the file is a packet file
- YYYYDOYhhmm is the time tag of the first error-free TLM Transfer Frame from which the L0 packet file was generated, where:
  - YYYY is the calendar year
  - DOY is the day of year
  - hh is the hour
  - mm is the minute
- nnnnn is the Pass Number in which the Transfer Frame was received at Malindi (nnnnn in decimal representation)
- VCNN is the Virtual Channel ID (NN in decimal representation)
- ppppp represents the APID of the packets contained within the packet file (If the file is a composite of all APIDs from the frame file, the APID number will be 99999.)
- 0 is a fixed field
- gz is the extension indicating the file is compressed with gzip

In the event of a data anomaly, suspect packet files can be traced to their parent frame files via time stamp and pass number. Example L0 file names are as follows:

```
PKT_20031040234_02343_VC01_00873.0.gz
PKT_20050992359_16534_VC01_99999.0.gz
```

3.1.3 Data Transfer Mechanism

A data delivery content listing, or signal file, will be provided with each set of L0 products generated from a telemetry frame file. The signal file will consist of an ASCII text file listing the complete path and file names of all created L0 packet files. The L0 signal file will be delivered by the MOC to the SDC via FTP or secure equivalent when data is available for transfer. After the SDC receives the L0 signal file, the SDC will retrieve the L0 products indicated in the signal file from the MOC via FTP or secure equivalent.

After a complete pass of L0 data is available and a L0 signal file has been sent for each completely processed telemetry frame file, a "pass completed" signal file will be delivered to the SDC via FTP or secure equivalent.

The L0 signal file naming convention will be as follows:

```
SIG_YYYYDOYhhmm_nnnnn_VCNN.txt
```

where:

- SIG is a fixed field indicating that the file is a signal file
- YYYYDOYhhmm is the time tag of the first error-free TLM Transfer Frame from which the L0 packet files were generated, where:
  - YYYY is the calendar year
  - DOY is the day of year
  - hh is the hour
  - mm is the minute
- nnnnn is the Pass Number in which the Transfer Frame was received at Malindi (nnnnn in decimal representation)
- VCNN is the Virtual Channel ID (NN in decimal representation)
- txt is a fixed field file extension

The file format of the L0 signal file will be as follows:

```
hostname:/path/filename1.gz
hostname:/path/filename2.gz
hostname:/path/filename3.gz
```

where:

-
- hostname is the fully qualified domain name of the computer that the SDC must log into
- path is the directory on the hostname computer that the L0 files reside in
- filenamex is the L0 filename to retrieve
- gz is the extension indicating the file is compressed with gzip

Example L0 signal file filename:

SIG_20033452302_55555_VC03.txt

Example L0 signal file contents:

```
swiftopen.psu.edu:/home/sdc/PKT_20033452302_55555_VC03_00873.0.gz
```

```
swiftopen.psu.edu:/home/sdc/PKT_20033452302_55555_VC03_00874.0.gz
swiftopen.psu.edu:/home/sdc/PKT_20033452302_55555_VC03_00875.0.gz
swiftopen.psu.edu:/home/sdc/PKT_20033452302_55555_VC03_00876.0.gz
```

The "pass completed" signal file naming convention will be as follows:

```
SIG_YYYYDOYhhmm_nnnnn_VCall.txt
```

where:

- SIG is a fixed field indicating that the file is a signal file
- YYYYDOYhhmm is the AOS time of the pass, where:
  - YYYY is the calendar year
  - DOY is the day of year
  - hh is the hour
  - mm is the minute
- nnnnn is the Pass Number in which the Transfer Frame was received at Malindi (nnnnn in decimal representation)
- VCall is a fixed text field denoting all VC files complete
- txt is a fixed field file extension

The file format of the "pass completed" signal file will be as follows:

```
hostname:/path/filename1.gz
hostname:/path/filename2.gz
hostname:/path/filename3.gz
hostname:/path/acs_filename.txt.gz
```

where:

- hostname is the fully qualified domain name of the computer that the SDC must log into
- path is the directory on the hostname computer that the L0 files reside in
- filenamex is the L0 filename
- acs_filename is the ACS Timeline filename *
- txt is a fixed field file extension
- gz is the extension indicating the file is compressed with gzip

* Note: The ACS Timeline file will be the last entry in the pass completed signal file only if VC6 was processed in that pass.

Example "pass completed" signal file filename:

SIG_20033452300_55555_VCall.txt

Example "pass completed" signal file contents:

swiftopen.psu.edu:/home/sdc/PKT_20033452302_55555_VC03_00873.0.gz
swiftopen.psu.edu:/home/sdc/PKT_20033452302_55555_VC03_00874.0.gz
swiftopen.psu.edu:/home/sdc/PKT_20033452302_55555_VC03_00875.0.gz
swiftopen.psu.edu:/home/sdc/PKT_20033452302_55555_VC03_00876.0.gz
swiftopen.psu.edu:/home/sdc/PKT_20033452302_55555_VC06_00875.0.gz
swiftopen.psu.edu:/home/sdc/PKT_20033452302_55555_VC06_00876.0.gz
swiftopen.psu.edu:/home/sdc/ACS_2003343_2003345_2003345_2305.txt.gz

Note that the sequence in which the signal files are sent in normal operations mode are:

- L0 Signal file(s)
- ACS Signal file
- Pass Completed Signal file

3.2 ACS TIMELINE

The MOC will generate a functional Attitude Control System (ACS) timeline to aid in SDC processing. This ACS timeline will consist of discrete start and stop times for each observation paired with its associated observation number. The ACS timeline is used to definitively indicate for any given time the corresponding observation number.

This data will be extracted from an ITOS sequential print of the SISCATTITUDE message (ACS parameters). After each ground-station pass, the MOC will sort new ACS packets by packet time. Sets of adjacent packets with identical observation numbers (i.e., packets separated by time intervals shorter than TBD [To Be Determined] and with no intervening packets) will be identified. The MOC will construct a timeline consisting of each interval's observation number, the time stamp of the first ACS packet in the interval, and the time stamp of the final packet in each interval. New interval data from each pass will be merged with the existing ACS timeline; overlapping intervals of dissimilar observation number will require operator intervention. This ACS timeline will be exported as an ASCII text file containing the following information in columnar format with '|' separators:

- Observation start time in YYYY-DOY-HH:MM:SS.ssssss format, where:
  - YYYY is the calendar year
  - DOY is the day-of-year
  - HH is the hour
  - MM is the minute
  - SS is the second
  - ssssss is the microseconds
- Observation stop time in YYYY-DOY-HH:MM:SS.ssssss format
- Observation start time in seconds and subseconds of Swift time (seconds since spacecraft epoch time) in SSSSSSSSSS.ssssss format (6 bytes), where:
  - SSSSSSSSSS is the second
  - ssssss is the subsecond

- Observation stop time in seconds and subseconds of Swift time in SSSSSSSSS.ssssss format (6 bytes)
- Observation Number (4-byte combination of target ID and observation segment number)

The ACS Timeline file naming convention will be as follows:

```
ACS_YYYYDOY_YYYYDOY_YYYYDOY_hhmm.txt.gz
```

where:

- the first YYYYDOY indicates the year and day of the first included observation
- the second YYYYDOY indicates the year and day of the final included observation
- the third timestamp (YYYYDOY_hhmm) indicates the date and time of the most recent file modification
- the .txt is an extension indicating a text file
- gz is the extension indicating the file is compressed with gzip

All ACS Timeline data will be maintained in a single file for the life of the mission. After any subsequent VC6 re-dumps containing the same time interval, any new ACS information will be merged with the existing ACS Timeline file. The MOC will deliver the entire updated file to the SDC via FTP or secure equivalent. A signal file will be sent to the SDC after the file has been updated for the pass, providing that a VC6 TLM file was processed in that pass. If VC6 was not processed, no signal file will be sent for the ACS Timeline.

The ACS Timeline signal file naming convention will be as follows:

```
SIG_YYYYDOYhhmm_nnnnn_ACS.txt
```

where:

- SIG is a fixed field indicating that the file is a signal file
- YYYYDOYhhmm is the time tag of the first error-free TLM Transfer Frame from which the L0 packet files were generated, where:
  - YYYY is the calendar year
  - DOY is the day of year
  - hh is the hour
  - mm is the minute
- nnnnn is the Pass Number in which the Transfer Frame was received at Malindi (nnnnn in decimal representation)
- ACS is a fixed text field indicating an ACS Timeline signal file
- txt is a fixed field file extension

The file format of the ACS Timeline signal file will be as follows:

```
hostname:/path/acs_filename.gz
```

where:

- hostname is the fully qualified domain name of the computer that the SDC must log into
- path is the directory on the hostname computer that the ACS file resides in
- acs_filename is the ACS Timeline filename to retrieve
- gz is the extension indicating the file is compressed with gzip

Example ACS Timeline signal file filename:

SIG_20033452302_55555_ACS.txt

Example ACS Timeline signal file contents:

swiftopen.psu.edu:/home/sdc/ACS_2003340_2003345_2003345_2302.txt.gz

3.3 SPACECRAFT CLOCK OFFSET LOG

Swift's onboard clock consists of a 32-bit unsegmented seconds field and a 16-bit unsegmented subseconds field (incremented in 20 microsecond "ticks"). The MOC will monitor Swift's clock drift and periodically modify its Universal Time Correction Factor (UTCF). The UTCF consists of a 32-bit unsegmented seconds field (specifically, the 2's complement of time in seconds) and a 16-bit subseconds field. The MOC will maintain an archive of all clock offsets and correction factors.

An ASCII log file of all calculated clock offsets and UTCFs will be maintained for the life of the mission. The Swift clock offset will be calculated periodically, and a corresponding UTCF will be computed. If necessary, the MOC will uplink a new UTCF. The MOC will append each of these data points to the log file, and any UTCF sent to the spacecraft will be indicated. The MOC will deliver the file to the SDC via FTP or secure equivalent once per week.

Each clock offset log entry shall contain the information with "|" separators:

- Spacecraft Time (YYYY-DOY_HH:MM:SS.ssssss)
- Ground Receipt Time (YYYY-DOY-HH:MM:SS.ssssss)
- Delta adjustment for speed of light delay, equipment delay, etc. (S.ssssss)
- Signed Calculated Clock Offset (+/-S.ssssss, expandable to longer time formats: e.g., +/-MM:SS.ssssss)
- Signed Current UTCF (+/-S.ssssss, expandable to longer time formats)
- Signed Uplinked UTCF (+/-S.ssssss, expandable to longer time formats, or "N/A" flag if UTCF not uplinked)
- Timestamp of UTCF uplink (if associated UTCF is uplinked)

A data format example is included in Appendix A.1.

The clock offset log file naming convention is as follows:

```
CLOCKOFFSET_YYYYDOY_YYYYDOY_YYYYDOY_hhmm.txt
```

where:

- the first YYYYDOY indicates the year and day of the first included clock correlation measurement
- the second YYYYDOY indicates the year and day of the final included clock correlation measurement
- the third timestamp (YYYYDOY_hhmm) indicates the date and time of the most recent file modification
- .txt is an extension for file type readability

3.4 NORAD TLEs

The MOC shall provide Swift orbit data to the SDC for use in high-level science product generation. This data will consist of North American Aerospace Defense Command (NORAD)-formatted Two-Line Elements (TLEs). The MOC will provide these TLE sets to the SDC no later than 7 days after the end of the associated mission day. Orbital elements, rather than propagated ephemerides, are supplied to the SDC to support independent orbit propagation. High-level science products may require higher time-resolution orbit position data than is feasible with static ephemerides.

The TLE format (with example) is as follows, with bit order starting at 1:

```
SWIFT
1 34981U 03194A   03292.88792001 +.00000584 +00000-0 +12775-3 0  1099
2 34981  24.9873 129.8847 0000001 201.0811 122.3124 13.94445942 10104
```

Table 3-4: TLE Line 1 Definition

Field Name	Bit/Column
Line Number	1
Blank	2
NORAD Catalog Number	3-7
Security Classification ("U" = unclassified)	8
Blank	9
Launch Year (bits 10-17 are the UN catalog number)	10-11
Launch Number of Launch Year	12-14
Piece of Launch	15-17
Blank	18
Epoch Year	19-20
Epoch Day of Year	21-23
Epoch Fraction of Day	24-32

Field Name	Bit/Column
Blank	33
First Time Derivative of Mean Motion (revolutions per day squared)	34-43
Blank	44
Second Time Derivative of Mean Motion (revolutions per day cubed; decimal point assumed)	45-52
Blank	53
Bstar Drag Term	54-61
Blank	62
Ephemeris Type (almost always “0” in practice)	63
Blank	64
Element Set Number (nominally incremented sequentially for a given object)	65-68
Checksum Value	69

Table 3-5: TLE Line 2 Definition

Field Name	Bit/Column
Line Number	1
Blank	2
NORAD Catalog Number	3-7
Blank	8
Inclination (degrees)	9-16
Blank	17
Right Ascension of Ascending Node (degrees)	18-25
Blank	26
Eccentricity (decimal point assumed)	27-33
Blank	34
Argument of Perigee (degrees)	35-42
Blank	43
Mean Anomaly (degrees)	44-51
Blank	52
Mean Motion (revolutions per day)	53-63
Revolution number at epoch	64-68
Checksum Value	69

The MOC shall retrieve TLE sets from the NASA Orbital Information Group (OIG) (or an equivalent third-party source). New TLE sets will become available approximately every 4 days.

The MOC shall make each newly retrieved TLE set available to the SDC on the MOC web site. The MOC shall also maintain a cumulative archive of all TLE sets for the duration of the mission. This archive shall consist of an ASCII text file on the MOC public web server. For operational convenience, the active (i.e., most recent) TLE set and the cumulative TLE archive shall reside in separate ASCII files. An example of the Swift TLE cumulative file format is included in Appendix A.3.

The TLE set file naming convention will be as follows:

```
SWIFT_TLE_ARCHIVE.txt              (cumulative file)
SWIFT_TLE_YYYYDOY_nnnnnnnn.tce     (active TLE set)
```

where:

- YYYYDOY indicates the date of the epoch for the TLE set
- nnnnnnnn indicates the fraction of the day of epoch
- .txt is an extension for file type readability
- .tce is an extension to enable STK compatibility

3.5 PREPLANNED SCIENCE TIMELINE

During each workday's science planning process, the MOC's science planning software shall produce a Preplanned Science Timeline (PPST). The Master PPST will contain the merged PPSTs for several days in the past and several days in the future. The Master PPST will be stored on the MOC public web server for retrieval by the SDC. Because of possible re-planning activities, the Master PPST may be updated several times during a single mission day.

The Master PPST shall be in ASCII and contain information in columnar format with '|' separators. The Master PPST format is shown in Table 3-6.

Table 3-6: Master Preplanned Science Timeline Format

Column	Description	Format
1	GMT Time of event	YYYY-DOY-HH:MM:SS
2	Type of event[1]	Text: PPT, SAA, …
3	Begin or End of event	Text: Begin or End
4	Target name	Text: Target name or Global [2]
5	Target ID	Unsigned integer (24 bits)
6	Observation segment	Unsigned integer (8 bits)

[1] The only type of event required for MPS is a "PPT" event. All other events are just informational and can be optionally excluded through TAKO.

[2] The 'Global' target name only applies to non-PPT event types such as SAA, which apply to all targets.

7	Observation number[3] (combination of target ID and observation segment)	Unsigned integer (32 bits): Low order 24 bits = Target ID High order 8 bits = observation segment
8	RA[3] of target in degrees decimal.	Floating point (64-bit)
9	DEC[3] of target in degrees decimal	Floating point (64-bit)
10	Roll[3] of spacecraft in degrees decimal	Floating point (32-bit)
11	BAT mode[3]	Unsigned integer (16-bit)
12	XRT mode[3]	Unsigned integer (16-bit)
13	UVOT mode[3]	Unsigned integer (16-bit)
14	Merit value[3]	Floating point (32-bit)
15	Requested Observation Seconds[3]	Unsigned integer (32-bit)
16	Remarks	Text
17	Target Database Filename	Text

All items will be provided for Preplanned Target (PPT) type events. For non-PPT type events, only items in columns 1-4 will be provided.

The Master Preplanned Science Timeline naming convention will be as follows:

```
MasterPPST.txt
```

An archive of the master preplanned science timelines will be maintained and made available on the MOC public web server. The archived master preplanned science timeline files will contain entries prior to the current Master PPST file. New archive files will be created as needed so that each file is a manageable size. The archived Master PPST file naming convention is as follows:

```
MasterPPST_YYYYDOYhhmm_YYYYDOYhhmm.txt
```

where:

- MasterPPST is a fixed field indicating that the file is a Preplanned Science Timeline file
- YYYYDOYhhmm is the start and end timeframe covered within the file where:
  - YYYY is the calendar year
  - DOY is the day of year
  - hh is the hour
  - mm is the minute
- .txt is an extension for text file types

[3] These fields are contained in the FOPPTREQUEST command. Refer to the *Onboard Operational Messaging Interface Document* for detailed description of these fields.

3.6 AS-FLOWN SCIENCE TIMELINE

After each ground station pass, the MOC Timeline Monitor software will extract actual observation times and attitude data from new SSR (Solid State Recorder) data. An As-Flown Science Timeline will be created to conform to this "as-executed" spacecraft data. The As-Flown Science Timeline will be an ASCII file in columnar format with '|' separators. The file format is shown in Table 3-7.

Table 3-7: As-Flown Science Timeline Format

Column	Description	Format
1	GMT Time of event	YYYY-DOY-HH:MM:SS.ssssss
2	Type of event PPT = Pre-planned Target AT = Automated Target ToO = Target of Opportunity No ACS Data = Gap in ACS data, unable to validate Safe Point = Safe Point Target Safe Hold = Spacecraft in Safe Hold mode SAA = South Atlantic Anomaly Slew Settled = Spacecraft Completed Slew	Text: PPT, AT, ToO, No ACS Data, Safe Point, Safe Hold, SAA, Slew Settled
3	Begin or End of event	Text: Begin or End
4	Target name	Text: Target name or Global
5	Target ID	Unsigned integer (24 bits)
6	True Target ID	Unsigned integer (24 bits)
7	Observation segment	Unsigned integer (8 bits)
8	True Observation segment	Unsigned integer (8 bits)
9	Observation number (combination of target ID and observation segment)	Unsigned integer (32 bits): Low order 24 bits = Target ID High order 8 bits = observation segment
10	True Observation number (combination of target ID and observation segment)	Unsigned integer (32 bits): Low order 24 bits = Target ID High order 8 bits = observation segment
11	RA of target in degrees decimal.	Floating point (64-bit)
12	DEC of target in degrees decimal	Floating point (64-bit)
13	Roll of target in degrees decimal	Floating point (32-bit)
14	BAT mode	Unsigned integer (16 bit)
15	XRT mode	Unsigned integer (16 bit)
16	UVOT mode	Unsigned integer (16 bit)

17	Merit value	Floating point (32-bit)
18	PPT Observation State Validated = PPT validated with ACS data Partially Validated = Part of the PPT validated with ACS data, but not complete due to data gap Unvalidated = Unable to validate PPT due to data gap	Text equal to one of the 3 strings: VALIDATED PARTIALLY VALIDATED UNVALIDATED
19	Remarks	Text
20	Sequence number (11-digit zero-filled tag representation of the Observation number, concatenation of True Target Id and True Observation Segment)	Text

The As-Flown Science Timeline for each applicable mission day will be delivered within 7 days to the SDC via FTP or secure equivalent. Additionally, the MOC will maintain As-Flown Timelines for the previous 30 days on the MOC public web server.

The As-Flown Science Timeline file naming convention will be as follows:

```
AFST_YYYYDOYhhmm_YYYYDOYhhmm_VV.txt
```

where:

- AFST is a fixed field indicating that the file is an As-Flown Science Timeline file
- YYYYDOYhhmm is the start and end timeframe covered within the file where:
  - YYYY is the calendar year
  - DOY is the day of year
  - hh is the hour
  - mm is the minute
- VV is a two-digit version number incrementing from 01
- .txt is an extension for file type readability

3.7 COMMAND LOGS

The MOC will maintain Command Logs of every up-linked and verified command for the duration of the mission. Separate log files will be maintained for real-time commands and stored Absolute Time Sequence (ATS) command loads. Updated Command Logs in increments of 1 mission day shall be provided to the SDC via the MOC public web page within 7 days of the last relevant command execution.

3.7.1 Real-time Command Logs

Each command transmitted individually during a spacecraft contact session shall be logged in an ITOS event file. Based upon these event files, the MOC Delogger system will produce Real-time Command Logs for each commanding session. Command session logs from each mission day will be merged into a single daily Real-time Command Log product. Real-time Command Log filenames shall include the date (in day-of-year format) as follows:

```
RTCMD_YYYYDOYhhmm_VV.txt
```

where:
- RTCMD is a fixed field identifying the file type
- YYYY is the calendar year of the AOS (Acquisition of Signal) time of the associated ground station pass
- DOY is the day of year
- hh is the hour
- mm is the minute
- VV is the version number incrementing from 01

Real-time Command Logs will be made available to the SDC on the MOC public web server. An example Real-time Command Log format is included in Appendix A.1.

3.7.2 Stored Command Logs

The MOC Mission Planning System (MPS) will create a text summary of each stored (time-tagged) command transmitted to the Swift spacecraft. Stored Command Logs will consist of an ASCII-format contents list for each ATS command load. Stored Command Log filenames will consist of the date (in day-of-year format) and version number as follows:

```
STCMD_YYYYDOYhhmm_VV.txt
```

where:
- YYYY is the calendar year of the execution time of the first included command
- DOY is the day of year
- hh is the hour
- mm is the minute
- VV is the version number incrementing from 01
- .txt is an extension for file type readability

Each Stored Command Log will be made available to the SDC on the MOC public web server. An example Stored Command Log format is included in Appendix A.2.

3.8 INTEGRATED CONTACT SCHEDULE FILES

Integrated Contact Schedules contain start times, durations, and configurations for contact passes with Swift via Malindi, TDRSS, or backup ground stations. Integrated Contact Schedules will be generated at least once per week. The MOC shall provide each Integrated Contact Schedule to the SDC via the MOC public web page. The Integrated Contact Schedule file is an ASCII file in columnar format with ‘|’ separators. The file format is shown in Table 3-8. Comment lines begin with '#', and blank lines are permitted.

Table 3-8: Integrated Contact Schedule Format

Column	Description	Format
1	Begin - time of the start of the pass (AOS)	YYYY/DOY/HH:MM:SS
2	End – time of the end of the pass (LOS)	YYYY/DOY/HH:MM:SS
3	Duration – duration of the contact	HH:MM:SS
4	Station – station ID	Text: 3 character abbreviation (MAL, TDE, TDW, TDZ)
5	Rate – down-link data rate, Kb/sec	Unsigned integer
6	Pass – Ground station pass number; n/a for TDRSS	Unsigned integer
7	Service – service type (if applicable)	Text: For TDRSS: MAF, MAR
8	Antenna – antenna ID	Text: For ground stations, the antenna id; For TDRSS, indicates schedule type: DAS means this record is from a handover record under Demand Access System, WDISC means this is a scheduled contact
9	Config – configuration notes	Text

The ICS file naming convention is as follows:

```
ICS_yyyy_ddd_hhmmss_vv.txt
```

where:

- yyyy is the 4-digit year
- ddd is the 3-digit day of year (001-366)
- hhmmss is the hours, minutes and seconds
- vv is a version number. Initially, 00 and incremented if the contact schedule muxer makes additional runs for the same start time.
- .txt is an extension for file type readability

The date indicates the start time of the schedule (not necessarily the first data in the file). The file will contain all known Malindi and TDRSS scheduled contacts and DAS handovers after the start time.

Filename example: ICS_2001_355_123510_00.txt

3.9 ANOMALY NOTIFICATIONS

The MOC will notify the SDC after any spacecraft or instrument anomaly. This notification shall consist of e-mail dispatches from the Spacecraft Emergency Response System (SERS) anomaly-reporting software. As MOC resources allow, the MOC may provide the SDC with more detailed status updates during the anomaly resolution process. Subsequent anomaly status updates may also be posted on the Swift Web page.

APPENDIX A: PRODUCT EXAMPLES

A.1 Clock Offset Log Format Example

NOTE: All values in decimal notation.

```
2003-334-23:31:56.152760|2003-334-23:31:56.845233|0.523454|+0.169019|+0.169060|+0.169020|2003-334-23:33:45.231950
2003-335-01:00:34.672320|2003-335-01:00:35.450695|0.456543|+0.321832|+0.321840|N/A|
2004-089-03:04:34.876500|2004-089-03:04:34.871200|0.756543|-0.761843|-0.761860|-0.761840|2004-089-03:06:44.139370
```

A.2 Real-time Command Log Format

```
CMDSWIFEVT_00-004-1739.orb5824 Spacecraft Command Summary

00 00-004-17:18:23 NULL_EVENT: dsp_evtlog: opened (append) log file /usr/tcw.swif/logs/SWASEVT_00-004-1718.TMP
08 00-004-17:19:40  CMD_EVENT: ALERT: Number of retry has been changed to 0
08 00-004-17:19:40  CMD_EVENT: ALERT: Number of retry has been changed to 2
08 00-004-17:23:05  CMD_EVENT: ALERT: Verification Timeout (VC 0) on command                /snoop (Bypass)
09 00-004-17:23:05 CMD_VERIFY: Dequeued bypass command (VC 0):                 /snoop
09 00-004-17:23:05 CMD_VERIFY: Dequeued bypass command (VC 0):                 /snoop
08 00-004-17:39:22  CMD_EVENT: ALERT: Invalid Frame Sequence Number (57). Expected 0
08 00-004-17:40:07  CMD_EVENT: ALERT: Invalid Frame Sequence Number (57). Expected 0
09 00-004-17:40:25 CMD_VERIFY: Command verification (VC 0) on /SNOOP
08 00-004-17:40:40  CMD_EVENT: ALERT: Verification timeout interval has been changed to 79
09 00-004-17:40:45 CMD_VERIFY: Command verification (VC 0) on /LOAD
09 00-004-17:40:45 CMD_VERIFY: Command verification (VC 0) on /LOAD
09 00-004-17:40:47 CMD_VERIFY: Command verification (VC 0) on /LOAD
09 00-004-17:40:48 CMD_VERIFY: Command verification (VC 0) on /LOAD
09 00-004-17:40:49 CMD_VERIFY: Command verification (VC 0) on /LOAD
09 00-004-17:40:50 CMD_VERIFY: Command verification (VC 0) on /LOAD
09 00-004-17:40:52 CMD_VERIFY: Command verification (VC 0) on /LOAD
09 00-004-17:42:00 CMD_VERIFY: Command verification (VC 0) on /LOAD
08 00-004-17:42:17  CMD_EVENT: ALERT: Verification timeout interval has been changed to 15
09 00-004-17:42:22 CMD_VERIFY: Command verification (VC 0) on /SNOOP
09 00-004-17:42:52 CMD_VERIFY: Command verification (VC 0) on      /SBAKSECS SECS=(mtime),SUBSECS=(btime)
09 00-004-17:43:01 CMD_VERIFY: Command verification (VC 0) on /SNOOP
09 00-004-17:47:05 CMD_VERIFY: Command verification (VC 0) on /CRESETFILE SEB
09 00-004-17:47:08 CMD_VERIFY: Command verification (VC 0) on    /CONFIGFILE SEB, WRAP
09 00-004-17:48:21 CMD_VERIFY: Command verification (VC 0) on /CREADFILES name(scipar), name(acspar),
name(engpar), NOSEB, name(POINTER)
00 00-004-17:53:27 NULL_EVENT: dsp_evtlog: closing log file /usr/tcw.swif/logs/SWIFEVT_00-004-1718.TMP
```

A.3 Stored Command Log Format

```
2002 162/01:11:00 N TRI SACTCRESET
2002 162/02:54:37 N TRI SACTCRESET
2002 162/04:38:13 N TRI SACTCRESET
2002 162/06:21:43 N TRI SACTCRESET
2002 162/08:05:28 N TRI SACTCRESET
2002 162/10:00:00 N TRI BATNOOP_LO
2002 162/13:12:00 N TRI FOPPTREQUEST
OBSNUMBER=33554458,MERIT=100,RA=285.58,DEC=14.07,ROLL=0,REQOBSSECS=2384,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/13:55:00 N TRI FOPPTREQUEST OBSNUMBER=33554460,MERIT=100,RA=329.72,DEC=-
30.22,ROLL=0,REQOBSSECS=461,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/14:04:00 N TRI FOPPTREQUEST OBSNUMBER=33554434,MERIT=100,RA=129.14,DEC=-
1.86,ROLL=0,REQOBSSECS=1589,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/14:52:00 N TRI FOPPTREQUEST
OBSNUMBER=33554458,MERIT=100,RA=285.58,DEC=14.07,ROLL=0,REQOBSSECS=2384,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/15:35:00 N TRI FOPPTREQUEST OBSNUMBER=33554460,MERIT=100,RA=329.72,DEC=-
30.22,ROLL=0,REQOBSSECS=461,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/15:35:26 N TRI SACTCRESET
2002 162/15:44:00 N TRI FOPPTREQUEST OBSNUMBER=33554434,MERIT=100,RA=129.14,DEC=-
1.86,ROLL=0,REQOBSSECS=1498,BATMODE=0,XRTMODE=0,UVOTMODE=0
```

```
2002 162/16:32:00 N TRI FOPPTREQUEST
OBSNUMBER=33554458,MERIT=100,RA=285.58,DEC=14.07,ROLL=0,REQOBSSECS=141,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/16:44:00 N TRI FOPPTREQUEST OBSNUMBER=33554460,MERIT=100,RA=329.72,DEC=-
30.22,ROLL=0,REQOBSSECS=2321,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/17:22:31 N TRI SACTCRESET
2002 162/17:24:00 N TRI FOPPTREQUEST OBSNUMBER=33554434,MERIT=100,RA=129.14,DEC=-
1.86,ROLL=0,REQOBSSECS=1439,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/18:24:00 N TRI FOPPTREQUEST OBSNUMBER=33554460,MERIT=100,RA=329.72,DEC=-
30.22,ROLL=0,REQOBSSECS=2218,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/19:04:00 N TRI FOPPTREQUEST OBSNUMBER=33554434,MERIT=100,RA=129.14,DEC=-
1.86,ROLL=0,REQOBSSECS=1979,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/19:09:09 N TRI SACTCRESET
2002 162/20:04:00 N TRI FOPPTREQUEST OBSNUMBER=33554460,MERIT=100,RA=329.72,DEC=-
30.22,ROLL=0,REQOBSSECS=2218,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/20:44:00 N TRI FOPPTREQUEST OBSNUMBER=33554434,MERIT=100,RA=129.14,DEC=-
1.86,ROLL=0,REQOBSSECS=2698,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/20:55:51 N TRI SACTCRESET
2002 162/21:44:00 N TRI FOPPTREQUEST OBSNUMBER=33554460,MERIT=100,RA=329.72,DEC=-
30.22,ROLL=0,REQOBSSECS=2218,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/22:24:00 N TRI FOPPTREQUEST OBSNUMBER=33554434,MERIT=100,RA=129.14,DEC=-
1.86,ROLL=0,REQOBSSECS=2699,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/22:42:51 N TRI SACTCRESET
2002 162/23:24:00 N TRI FOPPTREQUEST OBSNUMBER=33554460,MERIT=100,RA=329.72,DEC=-
30.22,ROLL=0,REQOBSSECS=2218,BATMODE=0,XRTMODE=0,UVOTMODE=0
2002 162/23:57:59 N FOT SCATSSWITCH
```

A.4 Swift TLE Cumulative File Format:

```
SWIFT 1
1 34981U 03194A   01091.17917824  .00003186  00000-0  93968-3 0  2317
2 34981  24.9835 341.3417 0011318 105.3746 254.8012 14.39939177 93243
SWIFT 1
1 34981U 03194A   01090.13956723  .00002972  00000-0  87297-3 0  2322
2 34981  24.9838 347.6958 0011329  94.7440 265.4361 14.39932401 93090
SWIFT 1
1 34981U 03194A   01088.96133501 +.00002837 +00000-0 +83108-3 0 02339
2 34981 024.9838 354.9011 0011327 083.2313 276.9488 14.39925595092925
SWIFT 1
1 34981U 03194A   01088.89202703  .00002815  00000-0  82399-3 0  2347
2 34981  24.9839 355.3247 0011337  82.5196 277.6602 14.39925159 92915
```

A.5 As-flown Timeline File Format:

```
|2002-023-05:18:00|PPT|Begin|CAPELLA|0007||2||33554439||79.172083333333333|45.998027777777779|5.1|0|1|2|0.99|Partially
Validated|10142-01|
|2002-023-05:18:00|No ACS Data|Begin|||||0||||||||Validated||
|2002-023-05:20:00|No ACS Data|End|||||0||||||||Validated||
|2002-023-05:22:00|PPT|End|CAPELLA|0007||2||33554439||79.172083333333333|45.998027777777779|5.1|0|1|2|0.99|Partially
Validated|10142-01|
|2002-023-05:23:00|AT|Begin||5555||5||55555555||555.555555555555555|-55.555555555555555|5.5|0|1|2|0.99|Validated||
|2002-023-05:26:00|AT|End||5555||5||55555555||555.555555555555555|-55.555555555555555|5.5|0|1|2|0.99|Validated||
|2002-023-05:27:00|Safe Point|Begin|ETACAR|0005||2||33554437||161.266666666666668|-59.684444444444445|5.1|0|1|2|0.50|Partially
Validated|10126-01 |
|2002-023-05:30:00|No ACS Data|Begin|||||0||||||||Validated||
|2002-023-05:31:00|Safe Point|End|ETACAR|0005||2||33554437||161.266666666666668|-59.684444444444445|0|0|0|0|100|Partially
Validated|10126-01 |
|2002-023-05:32:00|Safe Point|Begin|V773 TAU|0002||2||33554434||63.553750000000001|28.203749999999999|0|1|3|2|2|Paritally
Validated|10103-01 |
|2002-023-05:33:00|No ACS Data|End|||||0||||||||Validated||
|2002-023-05:34:00|No ACS Data|Begin|||||0||||||||Validated||
|2002-023-05:36:00|No ACS Data|End|||||0||||||||Validated||
```

|2002-023-05:36:00|Safe Point|End|V773 TAU|0002||2||33554434||63.553750000000001|28.203749999999999|5.1|0|1|2|0.99|Partially Validated|10103-01 |

A.6 Integrated Contact Schedule Format:

```
#                               Integrated Contact Schedule
#                               Start Time: 2002/177/00:00:00
#                               Stop Time:  2002/177/00:00:00
#  Begin             | End               | Duration | Stn | Rate | Pass | Service | Ant | Config
2002/177/00:53:32 | 2002/177/01:05:20 | 00:11:48 | MAL | 100 | 1 | NA | 01 |
2002/177/02:42:31 | 2002/177/02:52:28 | 00:09:57 | MAL | 100 | 2 | NA | 01 |
2002/177/04:27:04 | 2002/177/04:38:06 | 00:11:01 | MAL | 100 | 4 | NA | 01 |
2002/177/06:17:03 | 2002/177/06:22:43 | 00:05:40 | MAL | 100 | 5 | NA | 01 |
2002/177/09:52:59 | 2002/177/09:58:37 | 00:05:38 | MAL | 100 | 7 | NA | 01 |
2002/177/11:37:36 | 2002/177/11:48:32 | 00:10:55 | MAL | 100 | 8 | NA | 01 |
2002/177/13:23:15 | 2002/177/13:36:09 | 00:12:54 | MAL | 100 | 9 | NA | 01 |
2002/177/15:10:24 | 2002/177/15:22:00 | 00:11:35 | MAL | 100 | 10 | NA | 01 |
2002/177/17:00:22 | 2002/177/17:05:58 | 00:05:36 | MAL | 100 | 11 | NA | 01 |
2002/177/22:25:30 | 2002/177/22:29:31 | 00:04:01 | MAL | 100 | 14 | NA | 01 |
2002/177/22:30:30 | 2002/177/23:30:30 | 01:00:00 | TDE | 4 | 0 | MAR | DAS |
2002/178/00:08:58 | 2002/178/00:20:15 | 00:11:16 | MAL | 100 | 15 | NA | 01 |
2002/178/01:54:36 | 2002/178/01:57:08 | 00:02:32 | MAL | 100 | 16 | NA | 01 |
2002/178/01:58:34 | 2002/178/02:07:42 | 00:09:07 | MAL | 100 | 16 | NA | 01 |
2002/178/03:41:57 | 2002/178/03:53:31 | 00:11:34 | MAL | 100 | 18 | NA | 01 |
2002/178/05:31:30 | 2002/178/05:38:19 | 00:06:48 | MAL | 100 | 19 | NA | 01 |
2002/178/09:08:36 | 2002/178/09:13:01 | 00:04:24 | MAL | 100 | 21 | NA | 01 |
2002/178/10:53:03 | 2002/178/11:03:22 | 00:10:19 | MAL | 100 | 22 | NA | 01 |
2002/178/12:38:31 | 2002/178/12:51:19 | 00:12:48 | MAL | 100 | 23 | NA | 01 |
2002/178/14:25:22 | 2002/178/14:37:24 | 00:12:02 | MAL | 100 | 24 | NA | 01 |
2002/178/16:14:42 | 2002/178/16:21:47 | 00:07:05 | MAL | 100 | 25 | NA | 01 |
2002/178/23:24:27 | 2002/178/23:35:04 | 00:10:36 | MAL | 100 | 29 | NA | 01 |
2002/178/23:30:30 | 2002/179/00:30:30 | 01:00:00 | TDE | 4 | 0 | MAR | DAS |
2002/179/01:09:50 | 2002/179/01:22:53 | 00:13:03 | MAL | 100 | 30 | NA | 01 |
2002/179/02:56:55 | 2002/179/03:08:55 | 00:12:00 | MAL | 100 | 32 | NA | 01 |
2002/179/04:46:02 | 2002/179/04:53:52 | 00:07:49 | MAL | 100 | 33 | NA | 01 |
2002/179/08:24:20 | 2002/179/08:27:17 | 00:02:57 | MAL | 100 | 35 | NA | 01 |
2002/179/10:08:30 | 2002/179/10:18:09 | 00:09:38 | MAL | 100 | 36 | NA | 01 |
2002/179/11:53:48 | 2002/179/12:06:26 | 00:12:37 | MAL | 100 | 37 | NA | 01 |
2002/179/13:40:24 | 2002/179/13:52:46 | 00:12:22 | MAL | 100 | 38 | NA | 01 |
2002/179/15:29:12 | 2002/179/15:37:29 | 00:08:16 | MAL | 100 | 39 | NA | 01 |
2002/179/22:39:59 | 2002/179/22:49:49 | 00:09:49 | MAL | 100 | 43 | NA | 01 |
2002/179/23:30:30 | 2002/180/00:30:30 | 01:00:00 | TDW | 4   | 0   | MAR | DAS |
2002/180/00:25:06 | 2002/180/00:38:01 | 00:12:54 | MAL | 100 | 44 | NA | 01 |
2002/180/02:11:51 | 2002/180/02:13:04 | 00:01:13 | MAL | 100 | 45 | NA | 01 |
2002/180/02:13:19 | 2002/180/02:24:17 | 00:10:57 | MAL | 100 | 46 | NA | 01 |
2002/180/04:00:38 | 2002/180/04:09:23 | 00:08:44 | MAL | 100 | 47 | NA | 01 |
2002/180/09:23:58 | 2002/180/09:32:52 | 00:08:53 | MAL | 100 | 50 | NA | 01 |
2002/180/11:09:07 | 2002/180/11:21:29 | 00:12:21 | MAL | 100 | 51 | NA | 01 |
2002/180/12:55:28 | 2002/180/13:08:07 | 00:12:38 | MAL | 100 | 52 | NA | 01 |
2002/180/14:43:49 | 2002/180/14:53:06 | 00:09:16 | MAL | 100 | 53 | NA | 01 |
2002/180/21:55:34 | 2002/180/22:04:27 | 00:08:52 | MAL | 100 | 57 | NA | 01 |
2002/180/23:40:25 | 2002/180/23:53:06 | 00:12:40 | MAL | 100 | 58 | NA | 01 |
2002/180/23:30:30 | 2002/181/00:30:30 | 01:00:00 | TDW | 4 | 0 | MAF | WDISC |
2002/181/01:26:53 | 2002/181/01:39:36 | 00:12:43 | MAL | 100 | 59 | NA | 01 |
2002/181/03:15:18 | 2002/181/03:24:52 | 00:09:33 | MAL | 100 | 61 | NA | 01 |
2002/181/05:06:21 | 2002/181/05:08:59 | 00:02:37 | MAL | 100 | 62 | NA | 01 |
2002/181/08:39:28 | 2002/181/08:47:31 | 00:08:03 | MAL | 100 | 64 | NA | 01 |
2002/181/10:24:28 | 2002/181/10:36:30 | 00:12:02 | MAL | 100 | 65 | NA | 01 |
2002/181/12:10:35 | 2002/181/12:23:24 | 00:12:49 | MAL | 100 | 66 | NA | 01 |
2002/181/13:58:32 | 2002/181/14:08:39 | 00:10:06 | MAL | 100 | 67 | NA | 01 |
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ACRONYM LIST

AOS	Acquisition of Signal
ACS	Attitude Control System
APID	Application Process ID
ASCII	American Standard Code for Information Interchange
ASI	Italian Space Agency
ATS	Absolute Time Sequence
BAT	Burst Alert Telescope
CCSDS	Consultative Committee for Space Data Systems
COTS	Commercial-Off-The-Shelf
CP_PDU	CCSDS Path Protocol Data Unit
CRC	Cyclic Redundancy Check
DAS	Demand Access Service
DEC	Declination
FITS	Flexible Image Transport System
FOT	Flight Operations Team
FTP	File Transfer Protocol
GCN	GRB Coordinates Network
GMT	Greenwich Mean Time
GNEST	Ground Network for Swift
GOTS	Government-Off-The-Shelf
GRB	Gamma-Ray Burst
GSFC	Goddard Space Flight Center
GZIP	GNU ZIP Compression
HEASARC	High Energy Astrophysics Science Archive Research Center
HTTP	Hypertext Transfer Protocol
ICD	Interface Control Document
ID	Identification
ISAC	Italian Swift Archive Center
ITOS	Integrated Test and Operations System
L0	Level zero
Mbps	Megabits per second
MOC	Mission Operations Center
MPS	Mission Planning System
NASA	National Aeronautics and Space Administration
NORAD	North American Aerospace Defense Command
OGIP	Office of Guest Investigator Program
OIG	Orbital Information Group
OMI	Omitron
PA	Pennsylvania
PDU	Packet Data Unit
PI	Principal Investigator
PPT	Preplanned Target
PSU	The Pennsylvania State University
RA	Right Ascension
RS	Reed-Solomon
SAA	South Atlantic Anomaly
S/C	Spacecraft
SCP	Secure Copy
SCID	Spacecraft Identifier
SDC	Swift Data Center
SERS	Spacecraft Emergency Response System

SN	Space Network
SOT	Science Operations Team
SRD	Science Requirements Document
SSC	Swift Science Center
SSR	Solid State Recorder
STK	Satellite Tool Kit
TAKO	Timeline Assembler, Keyword Oriented
TBD	To Be Determined
TDRSS	Tracking and Data Relay Satellite System
TLE	Two-Line Element
ToO	Target of Opportunity
UK	United Kingdom
UKDC	United Kingdom Data Center
UTCF	Universal Time Correction Factor
UVOT	Ultra-Violet Optical Telescope
VC	Virtual Channel
VCID	Virtual Channel ID
WWW	World Wide Web
XRT	X-Ray Telescope